ArupCommunications

George Wimpey City Limited

Commercial Street Manchester

Interference to Radio and TV Reception

PLANNING
ACK'D
REPLIED
RECD - 4 MAR 2008

ArupCommunications

George Wimpey City Limited

Commercial Street Manchester

Interference to Radio and TV Reception

February 2008

Ove Arup & Partners International Ltd
13 Fitzroy Street, London W1T 4BQ
Tel +44 (0)20 7636 1531 Fax +44 (0)20 7755 2211
www.arup.com

Job number 69905-00

Job title	Commercial Street Manchester		Job number 69905-00
Document title	Interference to Radio and TV Reception		File reference
Document ref	C1378		

Revision	Date				
Draft 1	15/01/03	Filename	0001MainReport.doc		
		Description	First draft		
			Prepared by	Checked by	Approved by
		Name	Tom Fernando	Tom Fernando	Jim Read
		Signature			
Issue	28/01/03	Filename	Issue report.doc		
		Description	Minor amendments to text of the report		
			Prepared by	Checked by	Approved by
		Name	Tom Fernando	Tom Fernando	Jim Read
		Signature			
Issue2	22/05/03	Filename	0001MainReportIssue3.doc		
		Description	Minor amendments to text of the report		
			Prepared by	Checked by	Approved by
		Name	Tom Fernando	Tom Fernando	Jim Read
		Signature			
Issue 4	20/02/08	Filename	Main Report Issue 4		
		Description	Addendum included to take account of changed design		
			Prepared by	Checked by	Approved by
		Name	Tom Fernando	Tom Fernando	Jim Read
		Signature			

Issue Document Verification with Document ☑

©Arup F8.5
QA Rev 1/01 1 November 2001

Job title	Commercial Street Manchester		Job number 69905-00
Document title	Interference to Radio and TV Reception		File reference
Document ref	C1378		

Revision	Date				
Draft 1	15/01/03	Filename	0001MainReport.doc		
		Description	First draft		
			Prepared by	Checked by	Approved by
		Name	Tom Fernando	Tom Fernando	Jim Read
		Signature			
Issue	28/01/03	Filename	Issue report.doc		
		Description	Minor amendments to text of the report		
			Prepared by	Checked by	Approved by
		Name	Tom Fernando	Tom Fernando	Jim Read
		Signature			
Issue2	22/05/03	Filename	0001MainReportIssue3.doc		
		Description	Minor amendments to text of the report		
			Prepared by	Checked by	Approved by
		Name	Tom Fernando	Tom Fernando	Jim Read
		Signature			
Issue 4	20/02/08	Filename	Main Report Issue 4		
		Description	Addendum included to take account of changed design		
			Prepared by	Checked by	Approved by
		Name	Tom Fernando	Tom Fernando	Jim Read
		Signature			

Document Verification with Document ✓

CONTENTS

		Page
1.	**INTRODUCTION**	1
2.	**SCOPE AND METHOD**	1
3.	**TECHNICAL BACKGROUND**	**1**
3.1	Signal Transmissions	1
3.2	Shadows	2
3.3	Reflections	2
3.4	Digital Services	3
4.	**IMPACT ASSESSMENT**	**3**
4.1	Radio Services	3
4.2	Satellite TV Services	3
4.3	Terrestrial TV Services	4
5.	**MITIGATION MEASURES**	**5**
5.1	Satellite TV Services	5
5.2	Terrestrial TV Services	5
6.	**CONCLUSIONS**	**6**
ADDENDUM		**7**
1.	Introduction	7
2.	Satellite television shadowing	7
3.	Terrestrial television shadowing	7
4.	Conclusion	7

1. INTRODUCTION

The proposed Commercial Street Manchester development in the centre of Manchester comprises two 8-storey wings, adjacent and at right angles to each other and interconnected by means of a foot-bridge at each level. One wing extends north-south and the other east-west. For purposes of this study, the former is referred to as the 'East Wing' and the latter as the 'South Wing'.

An Environmental Impact Assessment for the proposed development includes an assessment of its likely impact on broadcast radio and television reception.

This report details the areas in the vicinity of the development where broadcast radio and television reception are likely to be affected by the proposed development, describes mitigating factors, and suggests possible solutions to remedy these effects.

The report includes an Addendum, at the end of the report, that takes account of the design changes proposed in February 2008.

2. SCOPE AND METHOD

The scope of this investigation is the assessment of the potential impact by the proposed development, Commercial Street Manchester (OS ref. TQ834974), on the reception of broadcast television and radio services in the surrounding areas.

The investigation is carried out as a desk study based on:

- the planned location of the proposed development.
- design development documentation.
- the location of the proposed development in relation to the main radio and TV transmitters.
- principles of radio propagation.

3. TECHNICAL BACKGROUND

3.1 Signal Transmissions

Broadcast radio and off-air (terrestrial and satellite) television services use radio frequency signal transmissions.

In the UK, broadcast radio signals are transmitted at mainly VHF (very high frequency) as 'FM' from a network of radio transmitters. Some radio broadcasts are also made at lower radio frequencies: short wave at HF (high frequency), medium wave at MF (medium frequency), and long wave at LF (low frequency).

Terrestrial television services in the UK are transmitted from a network of high, medium and low power UHF (ultra high frequency) transmitters located around the country. Most Manchester sites receive signals from the high power transmitter at Winter Hill (OS ref. TQ600144).

Satellite television services in the UK are transmitted at SHF (super high frequency) at around 10 GHz. The orientation of satellite dishes for television reception in the UK is in a southerly direction, with azimuths of between 150° and 200° from North. The relevant satellites are located above the Equator and therefore from a northerly location such as London the satellites describe a curve in the southern sky. The elevation due to this varies between 21° and 30°.

Each type of service – radio, terrestrial television, and satellite television - is transmitted from a different set of radio frequency transmitters. The variation in transmitter location means that different services may be affected differently by the same building development. The differing wavelengths of each type of service imply that each type of signal will behave differently.

There are two main causes of poor signal reception as a result of large buildings or structures: shadows and reflections. A structure may cause one of these or both.

3.2 Shadows

Radio frequency signals travel in the same way as light, i.e. in straight lines. Just as something obstructing a light source creates an optical shadow, objects in a radio transmitter's line-of-sight create radio signal shadows behind them. These obstructions may be physical, for example a hill, or man-made, as in the case of a tall building. Within a signal shadow the received strength of a signal will be heavily reduced. There are, however, three circumstances that affect the strength and size of a shadow's effect on signals beyond an obstruction.

As in the case of light, radio frequency signals can diffract around obstacles, the amount of diffraction being dependent on frequency. Radio frequency signals have longer wavelengths than light and therefore can diffract through larger angles than light. LF signals diffract through the largest angles followed by MF, HF, VHF, UHF and then SHF. Due to diffraction, the length and shape of a signal shadow is effectively reduced. The positive effect of diffraction decreases the closer the receiver gets to the obstruction.

Another factor that reduces the effect the shadow has on signal strength 'behind' the building is the structure's composition. Solid concrete and brick constructions absorb far more of the initial signal permitting only a small percentage through, yet with buildings that are non-solid such as metallic lattice towers, the signal reduction is dependant on the density of the lattice and the signal's wavelength.

Finally, the location in which a building is constructed can affect the signal reduction due to shadowing simply by multiple and complex reflections from the surrounding buildings.

Hence the overall effect is a shadow of varying signal strength graded such that in the near vicinity of the tall building the signal is greatly reduced, a few hundred meters away the signal strength is diminished and a few of kilometres away the shadow can be described as negligible.

3.3 Reflections

As in the case of light, radio frequency signals can be reflected. Just as a mirror creates a reflected optical signal, physical or man-made objects such as buildings and structures can reflect radio signals. Thus, a receiver may receive two or more signals from the same source, a direct signal and one or more reflected signals. The reflected signals travel further and arrive at the receiver later than the direct signal. In the case of television, these delayed signals create a 'ghost' of the television image, slightly to the right of the main image. This type of interference to TV reception is known as ghosting.

Any conducting surface reflects radio waves, with metal impregnated glass and flat polished metallic structures providing the best surfaces for reflection. It is possible to minimise the amount of interference created by reflections from a building simply by reducing the amount of signal reflected off the building itself. In order to do this the reflecting surface must be designed with this in mind applying methods such as:

- Radio absorbing coating.

- Non-planar surfaces, either curved or irregular to scatter the reflections over a wide area reducing the signal strength.

The point at which the strength of the unwanted or reflected signal is 5% of the wanted or direct signal corresponds to a difference of 26 dB. This separation is used as the planning protection ratio for delayed images resulting from ghosting: the reflected signal must be at least 26dB away from the direct signal.

3.4 Digital Services

In May 2002, the Department of Culture Media and Sport commissioned a poll, which announced that over four in every ten households were now viewing digital television and that an expected 65% of the population would be by 2007. The UK Government has stated that analogue services are planned to be discontinued from 2006 – 2010.

There are three methods of receiving digital television services: cable, satellite and (free-t0-air) terrestrial. Cable TV services will be unaffected by new buildings and structures provided that the development does not interrupt actual cable routes. Satellite TV services may be interrupted due to the shadow created by the building, however owing to the elevation of satellites the shadows created by new developments will only be a few hundred metres long. Digital terrestrial TV signals will travel the same paths as those of analogue signals, yet the technology used in the transmission enables lower power reception and the use of Coded Orthogonal Frequency Division Multiplexing negates ghosting effects resulting from multi-path reflections.

4. IMPACT ASSESSMENT

4.1 Radio Services

The radio frequencies used for the transmission of broadcast radio – LF to VHF - are such that signals can penetrate to some extent through obstacles and the common method of reception includes the use of diffraction. Thus shadowing is not a problem. In addition, there is no phenomenon similar to ghosting in the case of radio reception. Thus, the proposed building is unlikely to cause any significant interference to radio reception. Hence, the assessment below covers interference to terrestrial and satellite television reception only.

4.2 Satellite TV Services

The height of the proposed building and the height of the satellite transmitters located above the horizon in a southerly direction with respect to the proposed building ensure that the worst case length of the shadow caused by the proposed building will be about 80m immediately north of the building.

It should be noted that the number of available satellites means that the area that does not have a clear line of sight to all satellites is quite wide but the area without a clear line of sight to any one satellite is very small.

Immediately north of the South Wing up to a distance of about 80m is an area that is not likely to depend on satellite TV services. However, immediately north of the East Wing up to a distance of about 80m are large apartment blocks where there is likely to be some penetration of satellite TV services.

Hence, the proposed development is likely to have a very small negative impact on satellite TV services. Potential mitigation measures in the area affected by the shadow caused by the proposed building are identified in Section 5.1 below.

4.3 Terrestrial TV Services

4.3.1 Shadows

The buildings in the vicinity of the proposed development receive all free to air terrestrial TV channels from the Winter Hill TV transmitter located about 24 km north west of Manchester at a height of about 1160m AOD. This has been confirmed by NTL, one of the maintainers of TV transmitters for BBC and ITV and maintainer of the Winter Hill transmitter. Drawing C001 shows the position of the proposed development in relation to the Winter Hill TV transmitter.

The proposed development is about 55m AOD in height and situated in Commercial Street in the centre of Manchester. Due to the relative position of the Winter Hill transmitter, using geometrical optics, it is possible to conclude that the proposed building is likely to produce a TV signal shadow in a south-easterly direction from the development.

Drawing C001 shows as a worst case the maximum extent of the shadow likely to be caused by the proposed development. Whilst any terrestrial TV receiver outside this region is not likely to be affected by the radio shadows caused by the proposed development, within the shadowed area there is some likelihood that terrestrial TV services may be affected.

Within the region identified as a shadow, any adverse effect due to the development will decrease with the distance of the TV receiver from the development. Even though the shadow extends to about 1.26 km from the development, when diffraction effects are considered, the shadowed area will be foreshortened and generally narrower.

A major proportion of the area in the shadow comprises either large roadways or the University buildings where the reception of terrestrial TV services is not an issue. Of the remaining area in the shadow – say, 40% as a worst case – there is a mixture of apartment blocks and office buildings. Whilst in the office buildings there is less likely to be a requirement for free to air terrestrial TV services, most residential apartment blocks will have some households that depend on terrestrial TV services that may be affected by proposed development.

It should be noted that the increasing uptake of digital TV services – Cable and Satellite TV – is likely to further reduce the number of households affected by reflections by the time the development has been completed.

Hence, the proposed development is likely to have a negative impact on a small number of households in the area where the proposed development is likely to cause shadowing of terrestrial TV services.

Potential mitigation measures in the area affected by the shadow caused by the proposed building are identified in Section 5 below.

4.3.2 Reflections

The proposed development will reflect signals from its metal and metal impregnated glass surfaces. Using geometrical optics, the directions of reflected signals can be investigated.

Due to the orientation of facades in relation to the Winter Hill transmitter, the north facing façade of the South Wing is the only façade of this wing of the development that is likely to reflect TV signals originating from the Winter Hill transmitter. All signals originating from the Winter Hill TV transmitter and incident on the north-facing façade of the South Wing are, however, likely to be reflected towards the East Wing of the development, resulting in no impact on any terrestrial TV receivers outside the development.

Due to the orientation of facades in relation to the Winter Hill transmitter, the west-facing façade of the East Wing is the only façade of this wing of the development that is likely to reflect TV signals originating from the Winter Hill transmitter. Some signals originating from

the Winter Hill TV transmitter and incident on the west-facing façade of the East Wing are, however, likely to be reflected towards the South Wing, resulting in no impact on any terrestrial TV receivers outside the development. Some signals originating from the Winter Hill TV transmitter and incident on the west-facing façade of the East Wing will be reflected towards an area south-west of the development. However, as a normal directional TV receiving antenna usually receives signals only from within about 60° on either side of the direction in which the antenna points and these reflected signals will make an angle that is well in excess of 60% with the direct signals received at any TV receiver in that area, these reflections are not likely to cause any significant impact on TV reception.

Hence, the proposed development is not likely to cause any adverse impact on terrestrial TV reception due to signal reflections.

5. MITIGATION MEASURES

5.1 Satellite TV Services

TV Services may be re-instated either by re-installing the receiving dish antenna in a different position where service becomes available or by subscribing to Cable TV services.

5.2 Terrestrial TV Services

5.2.1 Using Existing Services

Shadows are created by the placement of a solid object in the line of propagating waves and as such once a building or structure is in place, in principle, the shadow itself cannot be mitigated. The only factors that can be introduced in order to minimise the effect on local reception in the shadow area are to the actual reception sites themselves.

The mitigation measures that can be introdueed in the affected area to overcome the adverse effects caused by the proposed development are:

- Improving the receiving antenna. This involves the installation of a new higher gain antenna. This will provide two benefits; firstly, it will enhance the gain of the antenna and increase the received signal strength; and secondly, it will improve the antenna directional response, thus reducing the impact of reflected signals and shadows. The effect of shadows may be circumvented in some instances by making better use of diffracted direct signals and/or using reflected signals off other buildings.
- Relocating the receiving antenna. In some circumstances the interference is extremely localised and relocating the receiving antenna at another point in a building may be able to improve the received signal strength sufficiently. This may be because the effect of shadows is obviated by making better use of diffracted direct signals and/or using reflected signals off other buildings.
- Retuning the receiver equipment. This may also include realigning the existing antenna and maybe even replacing it with a re-located or new antenna. There may be alternative transmitters available whose signal is not affected by the new building. These can provide substitute services in affected areas.

5.2.2 Using New Services

The more extreme, i.e. expensive to implement, solutions to problems to reception caused by shadows is the provision of a completely new service. This could be in any one of the following forms:

- A digital cable telcvision service.

- A digital satellite television service.
- An alternative rebroadcast transmitter, i.e. a 'self help' system where a signal 'master' antenna feeds an amplified signal that is distributed either by cable or by radio to the affected buildings.

6. CONCLUSIONS

The proposed building:

- is likely to have no significant impact on the reception of broadcast radio services.
- is likely to affect satellite TV services in a very small area immediately to the north of the 'East Wing'. TV Services may be re-instated in this area either by re-installing the receiving dish antenna in a different position where service becomes available or by subscribing to Cable TV services.
- is likely to have no significant impact due to reflection effects on terrestrial TV reception.
- is likely to affect terrestrial TV services in a small number of households / commercial properties in the area where the proposed development is likely to cause shadowing of TV signals. The affected locations may be able to have television services restored by using one of the following methods as appropriate: installing a higher gain antenna or re-locating the existing antenna or re-pointing the existing antenna to another transmitter where possible.

ADDENDUM

1. Introduction

This report is an addendum to the Arup Communications report of 2003 on interference to radio and television reception likely to result from the proposed Commercial Street Manchester development. This report takes into account the change in the design of the massing of the building development, i.e. the addition of a structure of approximately 6m in height at roof level.

The 2003 report identified two main negative impacts, i.e. on satellite and terrestrial television reception, due to shadowing impacts likely to be caused by the building development.

2. Satellite television shadowing

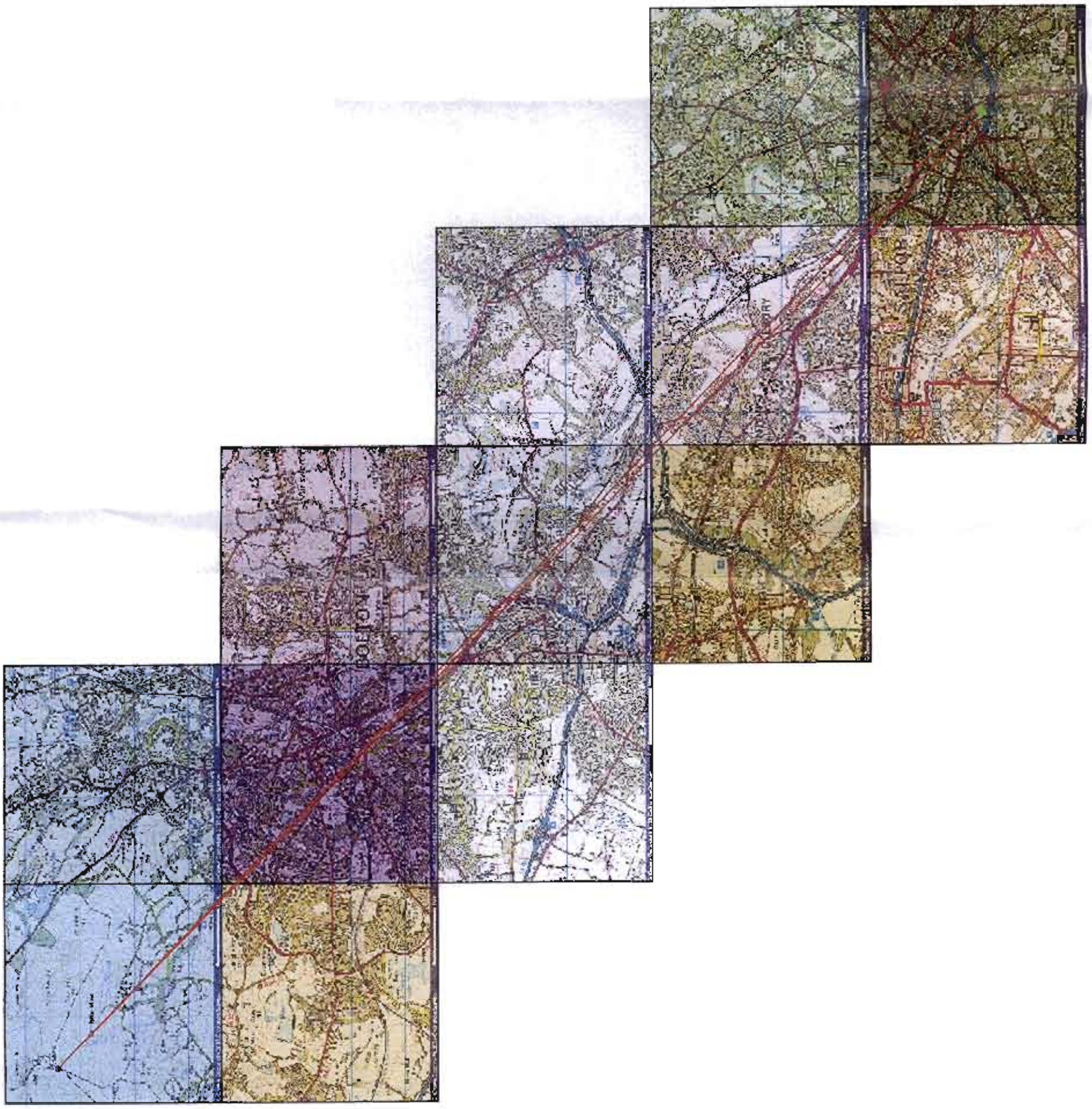
The small increase in height of the building development is likely to result in a slight increase in the shadowing impact likely to be caused by the building development. As the increase in impact is directly proportional to the increase in the height of the development, the changed design is likely to result in an approximately 10% increase in the impact area due to shadowing effects. Television services may be re-instated in this area either by re-installing the receiving dish antenna in a different position where service becomes available or by subscribing to cable television services.

3. Terrestrial television shadowing

The small increase in height of the building development is likely to result in a slight increase in the shadowing impact likely to be caused by the building development. It should be noted, however, that in the case of shadowing impacts of this nature, the further the shadow is from the development itself, the more likely is the shadowing impact to be swamped by diffraction effects due to the development. As a result, the shadowing impacts caused by the highest parts of the development are likely to be those that are in any case negated by diffraction effects. However, as the total shadow area is extended in absolute terms, there is likely to be some increase in adverse impacts resulting from the increase in height of the development. As in the case of shadowing of satellite television reception, the increase in shadowing impacts on terrestrial television reception is also likely to be around 10%. The affected locations may be able to have television services restored by using one of the following methods as appropriate: installing a higher gain antenna or re-locating the existing antenna or re-pointing the existing antenna to another transmitter where possible. If service cannot be reinstated by any of these methods, television services may be obtained by subscribing to satellite or cable television.

4. Conclusion

The 2003 report on interference to radio and television reception identified likely impacts on both satellite as well as terrestrial television reception as a result of shadowing effects from the proposed development. The approximately 10% increase in height of the development due to the change in the design is likely to result in an approximately 10% increase in the impact area in the case of both satellite as well as terrestrial television reception. However, mitigation measures are available for restoring television services.



ROTHERHAM
DONCASTER
A0

A0



TV SIGNAL
FROM
WINTER HILL
TRANSMITTER

LOCATION OF COMMERCIAL
STREET
DEVELOPMENT

TV SHADOW

ARUP

69905-00 C002 A